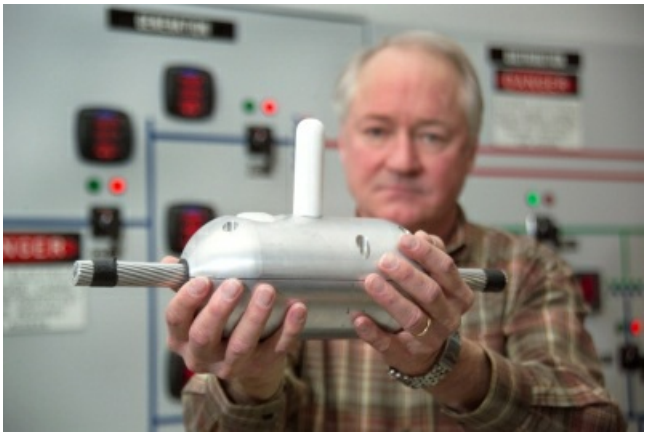

INL's Transmission Line Security monitor can remotely detect abnormal vibrations, temperatures and conditions around high-voltage transmission lines.

Transmission Line Security monitor can help protect nation's power grid

by Nicole Stricker, *INL Communications*

Electrical grids in the United States and around the world are vulnerable to terrorism, vandalism, physical deterioration and extreme weather. A small device invented at Idaho National Laboratory (INL) could now make it easier for operators to spot compromised lines and prevent widespread failures such as the 2003 blackout that affected the U.S. Midwest and East Coast.

The Transmission Line Security (TLS) monitor provides an inexpensive way to comprehensively monitor the electrical corridor. It can detect human tampering, natural threats such as earthquakes or fires, and dangerous conditions such as sagging power lines. It can discriminate between threatening and benign activity around power structures and it conveys real-time information to operators.

INL recently nominated the device for R&D Magazine's prestigious 2008 R&D 100 Awards, which recognize the most innovative ideas of the year. California-based Lindsey Manufacturing Co. (http://www.lindsey-usa.com/) has licensed the technology and will put TLS monitors on power lines this summer.

"We're setting up for a system operational test where it's placed on real transmission lines extending for many miles," said INL engineer John Svoboda.

An often unguarded critical resource
High-voltage transmission power lines strung from support towers form the backbone of the nation's electric power grid. Many of those 158,000 miles of lines, supported by nearly 800,000 towers, run through isolated areas as they deliver electricity from generating plants to cities.

Transmission lines have been damaged in the U.S. and around the world by terrorist activities, vandalism, extreme weather and theft of high-value aluminum conductor cables for sale on the black market. If not quickly addressed and isolated, small failures can escalate into costly, widespread blackouts.

Sagging power lines that went unnoticed by operators triggered the 2003 Ohio blackout that quickly spread to eight states in the U.S. Midwest and East Coast, and central Canada. The event affected 50 million people; cost billions of dollars in lost income, investments and commodities; and could have been averted had the problem been quickly detected and isolated.

But the investigation concluded that the Ohio regional power control agency did not have the computer tools to spot failures as they occurred and make compensating adjustments.

A sensible sentry
Such a tool now exists in INL's TLS monitor. The device scrutinizes the high-voltage power line, support tower and vicinity for signs of malicious human manipulation or threatening conditions. Infrared, acceleration, tilt and temperature sensors monitor lines for vibrations (caused by humans or nature), sagging and extreme heat. It can discriminate between suspicious human or vehicle activity and harmless animal presence.

"If it sees suspicious vibrations at the same time it sees a warm body, it says, 'Hmmm, I think there's somebody running around messing with our tower,'" Svoboda explained. "If there's no warm body, it may attribute the vibrations to a fallen tree or something."

The TLS monitor ignores benign activity but signals utility operators when it senses conditions that may threaten the transmission line. The monitors use radio frequency transceivers, which have a range of several thousand feet (support towers are usually spaced about 1,000 feet apart).

And unlike currently-available line sensors, the TLS monitors form a network, with each monitor acting as a transmission node to pass information along the corridor. Operators can interrogate a specific monitor to receive real-time information about conditions at that location.

If operators suspect a threat to the corridor, they can take steps to minimize the damage — such as reducing load, isolating part of the system or alerting law enforcement. If transmission line power is interrupted, the monitors can continue transmitting data for several minutes.

On the horizon
The self-contained monitors derive power from the magnetic field surrounding high-voltage power lines. TLS monitors need almost no maintenance and are expected to last decades without service. A single member of utility support team can use a special tool to clamp the oblong device — about the size of a small football — onto a live high-voltage line like a bun around a hot dog.

After successful tests at INL and a Bonneville Power Administration high-voltage lab, the monitors are ready for real-world demonstrations. This summer, the TLS units will be deployed on miles of lines in southern California. Long-term monitoring will watch for anomalies and help prove the system's value.

"There's a lot of situational awareness that this device provides the operators," said INL engineer Robert Polk. "So he can either provide a response from an electrical perspective or provide maybe a law-enforcement response."

Read INL's TLS monitor fact sheet here.
View INL's TLS monitor video here.

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